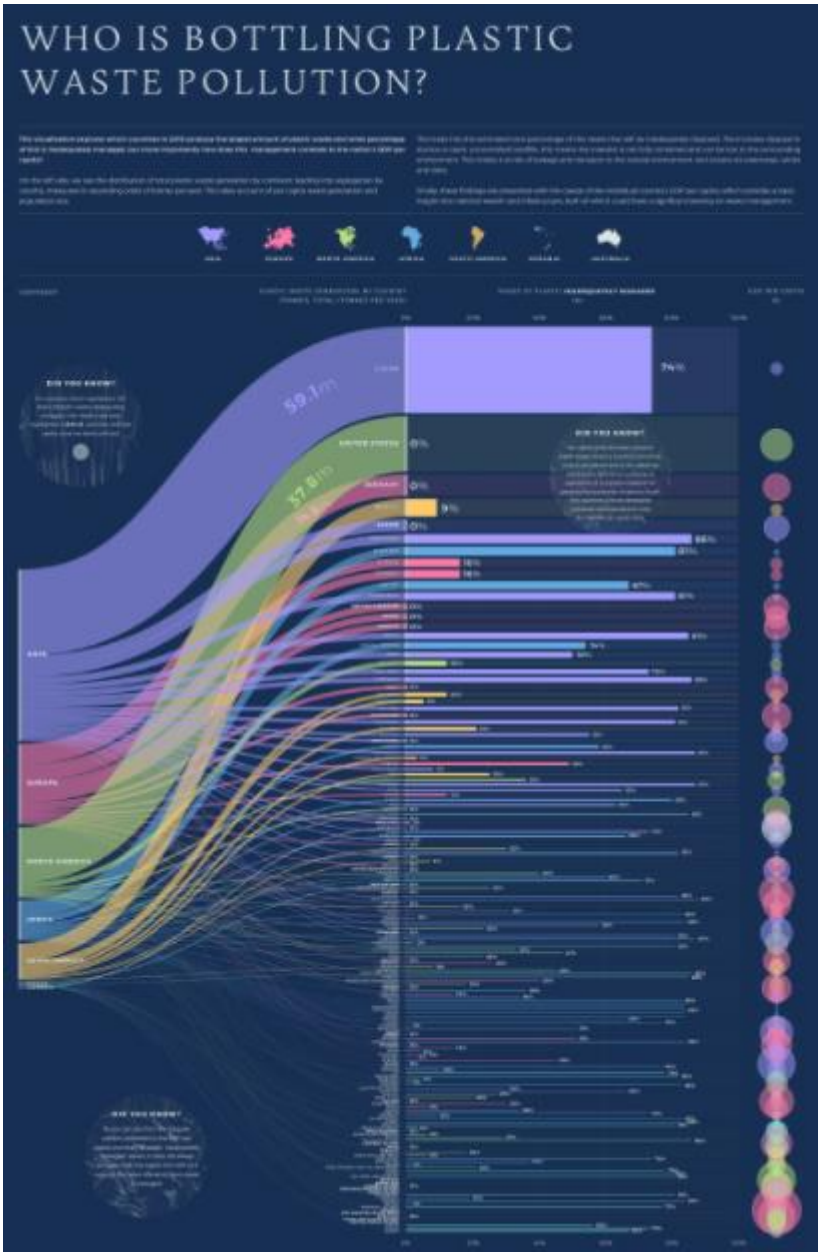
## Visualisation analysis blog post

The data visualisation I will be discussing is titled "Who is bottling plastic waste pollution?", created by Jamie Kettle (Kettle, J. 2020). The illustration, which is primarily a horizontal bar chart, displays both plastic waste generation and inadequate management of plastic by country, can be accessed here:

https://www.behance.net/gallery/106936329/Plastic-Waste-Pollution-data-visualisation

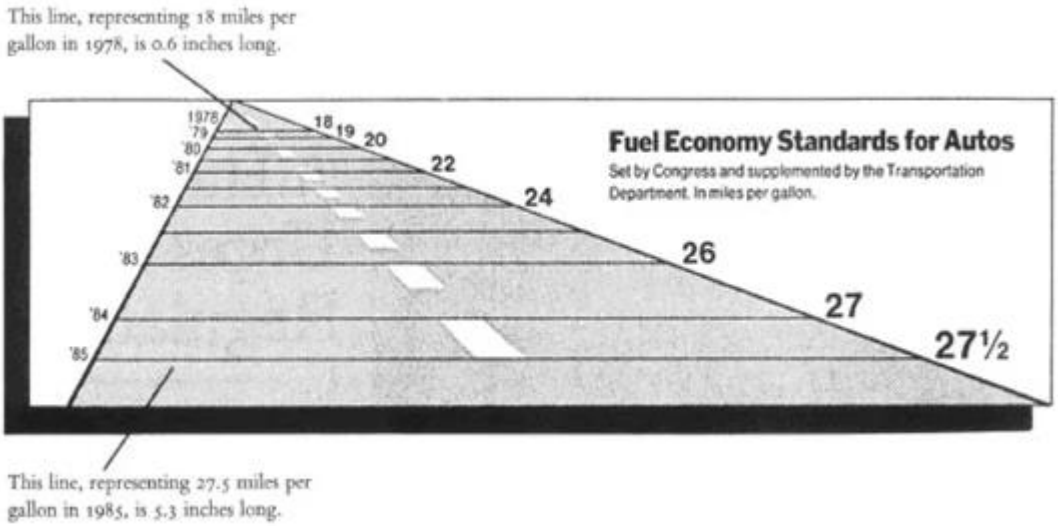



(Kettle, J. 2020)

Human perception plays an important role in visualization. An understanding of perception can significantly improve both the quality and the quantity of information being displayed (Ware, 2000). With this in mind, I will analyse this visualisation using different frameworks and materials I have been exposed to. A concise definition of data visualisation that focuses on the primary concepts in the digital age comes from Shneiderman, "Information visualization is the use of computer-

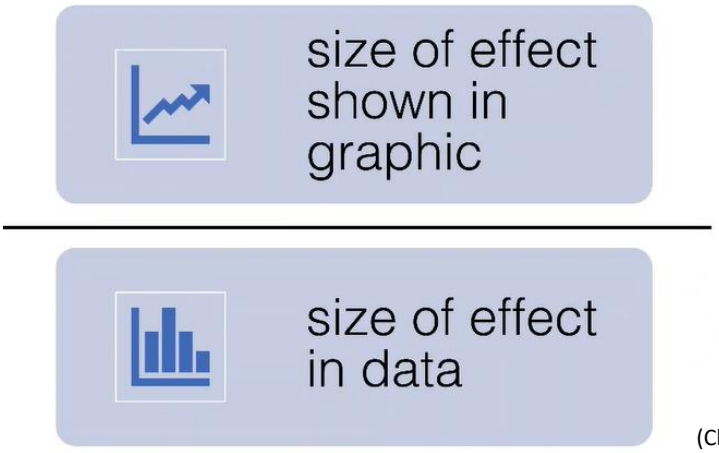
supported, interactive, visual representation of abstract data in order to amplify cognition" (Mackinlay, C. 1999).

Most analyses of data visualisations start with Tufte's rules from the book "Visual Display of Quantitative Information". Edward Tufte defines a set of principles to analyse effective visualisations. The first principle is "Graphical Excellence", which assesses how well designed the visualisation, presentation, substance, data, and design are all combined. Tufte offers that in data representations at least it should provide the user with; "the greatest number of ideas, in the shortest time, using the least amount of ink, in the smallest space." (Interaction-design, 2020). Tufte further adds that visualisations should communicate complex ideas with clarity, precision and efficiency while telling the truth about the data. Applying these concepts to Kettle's graphic, the illustration demonstrates graphical excellence as it displays complex data elegantly without distortion. Tufte's second principle is "Graphical integrity", which assesses the fairness and truth in the graphic, this involves showing variation in data, not design.



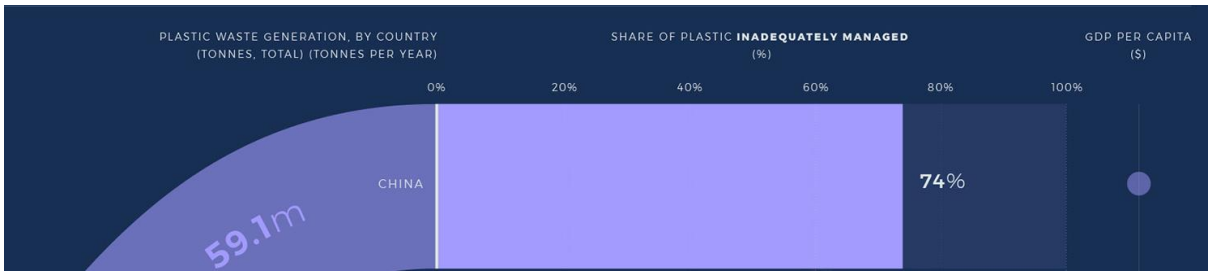

Tufte's example of misleading proportions being represented in a visual graphic (TheDoubleThink, 2010)

When Tufte refers to "visual integrity" he is invoking an almost moral position in that the representation should neither distort the underlying data nor create a false impression or interpretation of that data (Interaction-design, 2020). Kettle's graphic provides a detailed context below the title to help understand the story and data involved along with a fair 'Lie factor'. Tufte's lie factor equation is show below.



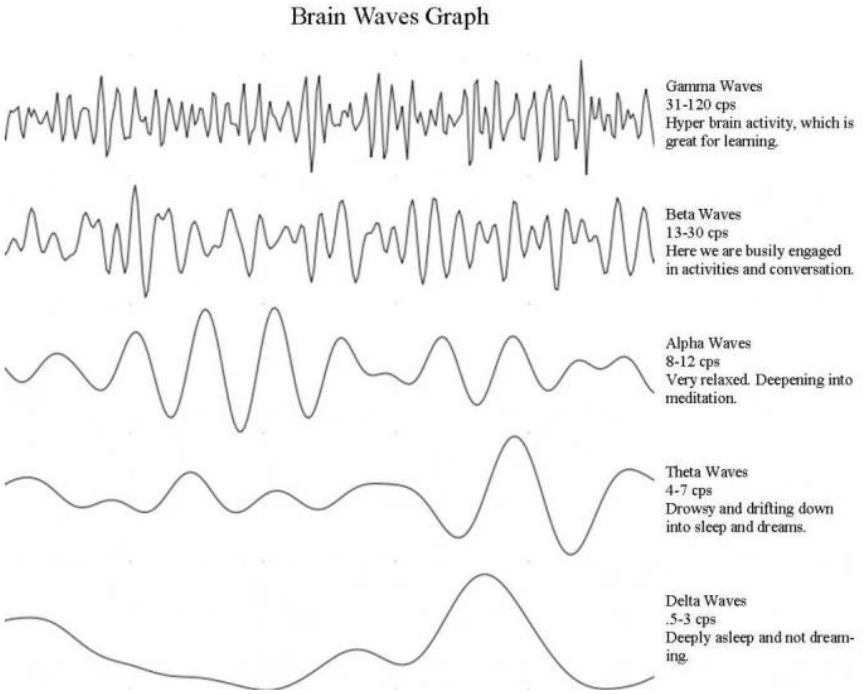

(Chorley, M.2022)

Tufte mentions how fair measures over time can be, such as inflation affecting the value of money, in Kettle's graphic there is a case to be made that taking GDP per capita and plastic pollution from only 2010 can be an unfair representation to developing countries, especially China which has the highest human population, they are producing more waste currently whereas developed countries have produced vast amount of waste in the past. GDP per capita can be misleading in regards to overall GDP of a country and there is a lack of context and scale before or after 2010.




The use of total plastic waste compared to GDP per capita can create a false image for countries with large populations, as you can see from the graphic, the most populous countries are producing the most waste. The metrics should be comparable, if you are using total plastic waste, total GDP would be a fairer representation.

Tufte claims that good graphical representations maximize data-ink and erase as much non-data-ink as possible, the equation for this is, the data-ink divided by the amount of total ink (TheDoubleThink, 2010).



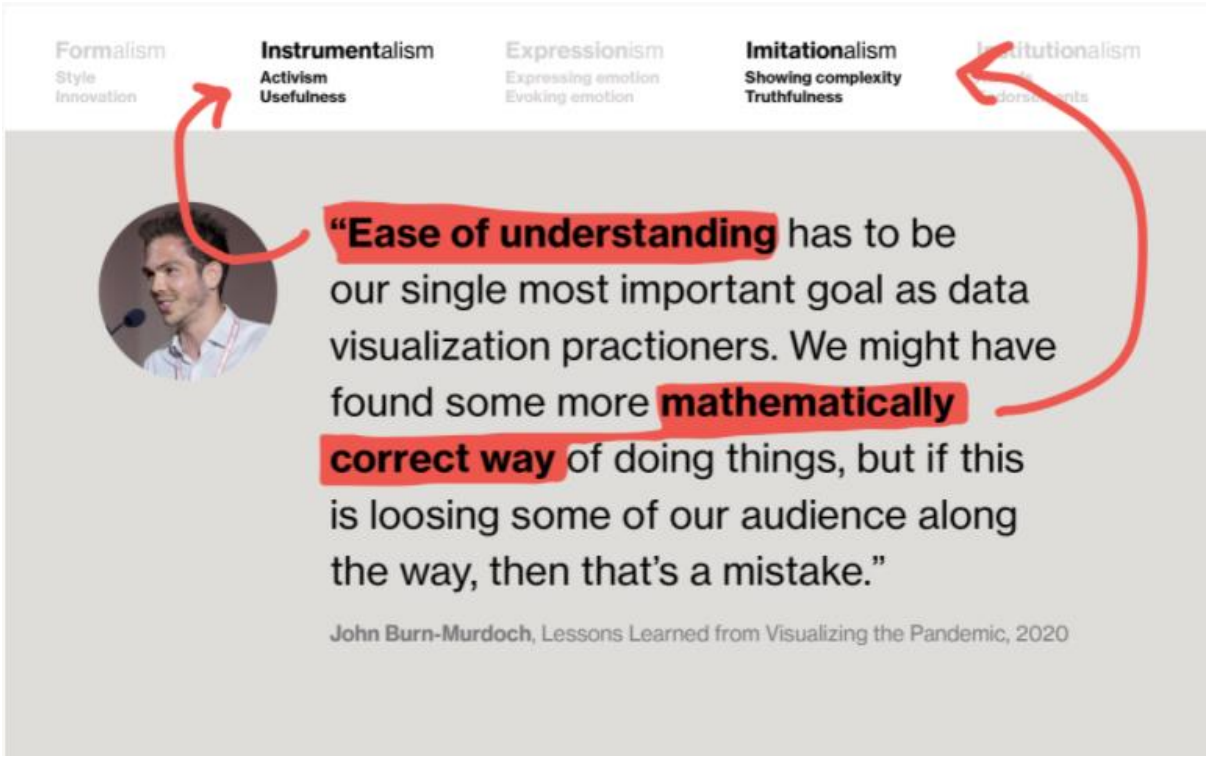

This graph would be a great representation of a high data to ink ratio

(TheDoubleThink, 2010)

Tufte offers the idea that borders, backgrounds, use of 3D, etc. may do nothing but serve to distract the user from the information itself (Interaction-design, 2020). Applying this principle, I would summarise that Kettle's graphic would be regarded as a low data to ink/pixel ratio, this does not

mean that is a bad data visualisation by default. The graphic handles substantial amounts of data and multiple different labels for the x-axes but the left side of the chart is mostly non-data pixels which may be labelled as 'Chart Junk' by Tufte. In this instance, there is an argument for it being labelled as data-ink because it provides a purpose representing continents in a clever and distinguished method. The artist has tried to fill the non-data ink by using 'Did you know?' bubbles which add extra context and explanation.

Tufte's guidelines are not prescriptive but rather designed to assist the information visualization professional in creating usable and useful information representations. At their core, his rules can be boiled down to keeping things as simple and as honest as possible (Interaction-design, 2020). Lisa Charlotte Muth offers a different perspective by applying five traditional European-American theories to data visualisation categories, Formalism, Instrumentalism, Expressionism, Imitationalism, and Institutionalism (Muth, L. 2020). These are used to help us understand the goals and rules of a visualisation. The categories that radiate with Kettle's graphic are Instrumentalism and Imitationalism with a smaller dose of Expressionism. The artist is trying to create a useful and accurate representation of complex data which could cause activism from evoking emotion by shocking its audience.




(Muth, L. 2020)

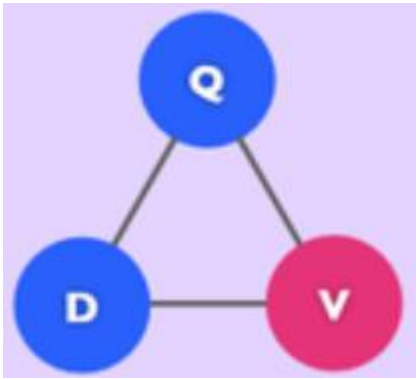
16 years before Tufte, there was a book called Semiology of Graphics, written by Jacques Bertin. Bertin organised the components in a graphic by quantitative, ordered or qualitative (Sluis, K. 2016). Applying this to Kettle's graphic, the labels on the y axes are qualitative as they are countries but are also ordered based on a quantitative value. Bertin highlights that relative size is the most widely useful and easily perceived visual variable, no matter what information is visualized (Sluis, K. 2016). This is directly linked to Kettle's graphic as total plastic waste is displayed using relative size to quickly reveal the comparison between plastic waste in each country. Not all Bertin's concepts apply

to Kettle's graphic, for example, Bertin's ideal amount of ink to white space is 5-10% whereas Kettle overloads the graphic with a blue background while also displaying more than 10% data. Bertin also highlights that focusing on fewer components in a graph aids memorization and allows freedom to use more exotic graphic forms (Sluis, K. 2016). Kettle's graphic does not follow this rule, as it fills the page with complex shapes, varying x axes and information resulting in individual components being easily forgettable, but it does create an exotic graphic.

Bertin describes three questions that a efficient should answer (Sluis, K. 2016).

1. **Elementary** question that focuses on a specific element of the graphic. In Kettle's graphic, this would be "How much plastic waste did China generate in total for 2010?".
2. **Intermediate** question that focuses on a group of elements and usually illuminates a trend. In our example, "Does a higher GDP per capita result in a lower percentage of plastic inadequately managed?".
3. **Overall** question that seeks an answer to the general message of the graphic. "Which continent has the highest percentage of adequately managed plastics?".

Another perspective comes from the Junk Chart Trifecta Checkup which focuses on three main elements, an interesting question with relevant data in combination with a visual which addresses the question in a clear, concise manner (Junk Charts, 2014). Kettle's graphic falls faintly into Type V, there is an intriguing question with relevant information, unfortunately, the visuals are not always easy to interpret and digest every data point.



(Junk Charts, 2014)

Research has demonstrated that aesthetics play a key role in shaping people's responses to any kind of product. Beauty cannot replace functionality, but beauty and functionality together achieve incredibly greater results. In this regard, we can define successful designs as the ones able to balance convention and novelty (Lupi, G. 2016). Healey discusses the importance of preattentive processing, this process involves tasks that can be performed on large multi-element displays in less than 200-250 milliseconds (Healey, 2012). There are no concepts that would visually stand out in the preattentive processing phase when looking at Kettle's graphic, you would quickly identify the varying colours and patterns but there are too much complexity to unravel to digest and memorise.

As Fung suggests, cognition is guided by design elements such as reference lines, legends, data labels and annotations (Fung, K. 2020). In this regard, Kettle's graphic does extremely well, it is clearly labelled, annotated and described in every aspect even when the changes in x-axes can be confusing. Fung argues that lengthy instructions are obviated when designers follow certain conventions and rules that are intuitively grasped by readers (Fung, K. 2020). In my opinion, it would

be better to remove the bubble which explains the trend between GDP per capita and inadequately managed plastics, the graphic should reveal this to the reader through the visuals.


Most conventions and rules in data visualisation are not unique, in some cases, competing, contradictory conventions co-exist (Fung, K. 2020). Using a combination of data visualisation rules, psychology and opinions can help us create and analyse our visualisations.
Overall, this is an effective and efficient visualisation. The way Kettle has used colours is consistent and aesthetically pleasing. The colours reflect a data difference and categorises them to help follow the geographical area the countries belong to. Personally, I would change the format of the 'Did you know?' bubble on the bar graph, I believe there should be consistency throughout the graphic without distraction from the data.


The layout of these bubbles appear almost as an afterthought, and filler, they are not aligned or structured. I value the context they add only if the context cannot be retrieved from the graphic itself, although I would argue that the visualisation itself must demonstrate these trends. Alternatively, the information provided in the context bubbles could have been included beneath the title where there is a designated section for information. Finally, I believe the graphic should have more clarity and spacing between countries at the bottom of the graphic. There are many countries such as Monaco that have no data on how much waste is inadequately managed, without this data, visualising these countries does not add any information to answer the title of this graphic.

On that note, there is no way to see which country's GDP per capita matches the colour coded continent key. These countries should be removed as they cause confusion and add no value.